DIVERS AND TELEVISION FOR EXAMINING RIVERBED MATERIAL AND POPULATIONS OF BLACK FLY LARVAE IN THE ATHABASCA RIVER

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Divers can be used successfully in identifying, by touch, characteristics of the riverbed, retrieving bottom material, and selecting locations for the placement of sampling equipment in water velocities of less than 2 m/sec. Divers were unable to estimate spring populations of black flies or to scan the riverbed in the silt-laden Athabasca River in Alberta using a closed-circuit television system. Retrieval of samples of black fly larvae from rapids and deep fast-water channels (> 2 m/sec) were not possible.

Dans les rivières où la vélocité du courant est moindre que 2 m/sec, des plongeurs permettent de reconnaître entouchant les caracteristiques du lit, d'obtenir des échantillons du lit, et de sélectionner l'emplacement d'équipments d'échantillonnage. En eau troublee les plongeurs n'ont pu estimer les populations printanières des mouches-noires ou de scruter le lit de la rivière Athabasca à l'aide d'un système fermé de télévision. De plus en courant de plus de 2 m/sec, les plongeurs n'ont pas réussi à récupérer des échantillons des stades larvaires de mouches-noires.

INTRODUCTION

Sampling the biota of large rivers, such as the Athabasca in Alberta, is necessary to evaluate population and control studies. At present, no reliable quantitative methods exist. The difficulties in large rivers are due to the depth and velocity of water and to the turbidity.

Methods of sampling now available can be used only to obtain population indices. In the Athabasca River, sampling for black fly larvae has been accomplished in deep water by using a boat to place artificial substrates for larval attachment (Depner unpublished, Fredeen 1974). Resident populations of non-target organisms living on or in the bottom were sampled by disturbing the bed material and catching the released organisms (Depner unpublished). However, investigators are limited to depths in which they can safely stand for the period required for sampling.

The technique of using artificial substrates (Depner unpublished, Fredeen 1974) for estimating larval populations is limited because it measures drifting populations. Even though this is an index of the sessile populations, the exact location and size of these populations cannot be determined precisely. Thus, it was felt that a technique of scanning attached larvae under natural conditions and correlating these population levels and locations to those identified using artificial substrates was required.

The feasibility of using closed-circuit television operated by a professional diving team to scan the riverbed was investigated in an attempt to locate sessile black fly larvae in the Athabasca River. This evidence would have been useful in pinpointing areas of black fly larval attachment in the river for correlation with other sampling methods in estimating the effect of control studies on black flies and other organisms.

MATERIALS AND METHODS

The tests described here were conducted on the Athabasca River in northern Alberta. River velocity varied from 0 to 2 m/sec with a flow rate of about 570 m^3/sec and turbidity at >14 JTU (Jackson Turbidity Units) on May 8 and 9, 1975. The weather was generally clear with air temperature of 12 C and minimal wind.

Two significant major requirements are necessary for conducting studies of this nature on large rivers: First, trained professional divers and second, a maneuverable boat or platform from which to operate. A crew of three professional divers complete with self-contained underwater breathing apparatus (Scuba), the necessary safety equipment, and direct boat-to-diver audio communication equipment was contracted. The aluminum boat used in the operation had a 7-m hull and a 350-hp inboard engine, which powered a Berkely jet-drive unit. Such a craft has the necessary stability, carrying capacity, and maneuverability in fast-flowing water. In addition, the jet drive allows access to shallow areas if necessary. In all situations, when divers were working in the water, the boat was securely anchored.

A three-diver team is the minimum for such an operation; one man dives, one controls the safety line, and the third is responsible for diver-boat communication.

Diver Examination of Bed and Sample Collection

By means of audio connection and by sense of touch, the divers were able to describe bottom topography and composition of the riverbed (*i.e.*, mud, sand, rock, sizes of rocks, etc.) in highly turbid water. In clear or very slightly turbid water, an underwater camera or television assembly could be used.

The divers were equipped with a coarse mesh bag for collecting larger bulk samples. This bag was connected to a separate line to allow for independent retrieval of collections. For collecting biological material, the coarse mesh bag was replaced by one with a fine mesh (12 strands /cm) which permitted the retention of organisms as small as second-instar black fly larvae. Sample collection was attempted at several locations in both shallow water (1.3 m deep) and in deep water (up to 5 m) at velocities up to 1 m/sec at slow-water sites, and above 1 m/sec at faster flowing sites. In shallow water, only snorkel equipment was used, whereas in deep water Scuba equipment was necessary.

Underwater Television for Riverbed and Insect Examination

A small portable Sony television camera in a waterproof case, connected to a video-tape recorder and monitor on the boat was used in this test. Light source consisted of four flood lamps attached to the camera case. Power was supplied by a 1500-W portable gasoline-powered generator in the boat.

The equipment was evaluated in several locations along the river in shallow and deep water of varying velocities.

RESULTS AND DISCUSSION

Diver Examination of Riverbed and Sample Collection

The reaches of the Athabasca River located beyond 100 km downstream of the town of Athabasca are known to have high populations of the black fly *Simulium arcticum* and for this reason attempts at sample retrieval were made at three points in this area. It was found at every site that the diver could maneuver successfully only in relatively quiet water (< 1 m/sec). The parts of the river in which these conditions exist are, however, not the conditions under which the larvae of *S. arcticum* are found. Attempts to have the diver work in the deep channels

and rapids where the water flows swiftly and where it was hoped that black fly larvae could be obtained, failed for two reasons. First, it was almost impossible to anchor the boat securely in fast water and, secondly, the diver was unable to control his attitude and movements underwater. In one instance at a point 200 km downstream, the boat was anchored in relatively quiet water at the edge of a fast channel. The diver was allowed to move back on his safety line to a point 60 m behind the boat. At that point, he attempted to move laterally into the fast water of the channel. Each of several attempts was unsuccessful as he was immediately swept back into quiet water with no more than minimal and momentary penetration of the faster water. These attempts were at the expenditure of much human energy, and also resulted in severe buffeting of the diver.

After this, attempts were made to obtain samples by wading in chest-deep water. These attempts were in an area of high larval black fly populations, as indicated by the attachment of larvae to artificial substrates in other work that was going on at the same time.

In all situations, the rocks recovered by the diver were not clean but were covered with algae, and were therefore not suitable as attachment sites for *S. arcticum* larvae. It was evident in this section of the river that the area in which the rocks were scoured clean by high current velocities could not be reached. Other bottom-dwelling organisms were obtained, but numbers were low since many were carried away by the current during transfer to the sample bag.

Although the divers were not successful in faster waters, they were valuable in the identification of the riverbed material and in the selection of locations for the placement of sampling equipment. It is important that these are placed so as not to be influenced by abnormal hydrological phenomena that would bias any results obtained from such equipment.

We are confident that, through a cooperative effort, a towable underwater sled with controllable hydrofoils operated by the diver could be developed for use in fast flowing turbid rivers.

Underwater Television for Bed and Insect Examination

In above-surface tests, the television equipment functioned well and picture quality on the monitor was excellent. The resolution was sufficient to identify floating objects such as small sticks and bubbles. However, no resolution was attainable in the picture when the camera was submerged. The lack of visibility was uniform, whether working in the main current or in quiet shallow water, regardless of depth.

The turbidity of the water (14 JTU) was far too great for penetration by the artificial lights. In addition, significant reflection of light from the water-borne silt particles effectively blinded the camera and registered on the monitor as a featureless flickering.

CONCLUSIONS

Highly turbid and fast flowing rivers pose significant problems to biologists and hydrologists in the systematic evaluation of phenomena that affect aquatic biology. Divers can be used successfully in identifying, by touch, characteristics of the riverbed at lower current velocities. However, research is needed to design equipment to make it possible for divers to work in faster flowing water. Similarly, procedures and equipment must be developed for recovery of insect material, especially black fly larvae, from riverbeds in deep, fast flowing water.

The use of closed-circuit underwater television is impractical in very turbid rivers because of reflection and lack of penetration of light from auxilliary sources.

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